DOCUMENT RESUME

ED 062 822 EM 009 890

AUTHOR Vollan, Clayton J.
TITLE Effects of Black and White, Authentic and Contrived Color on Children's Perceptions of Dynamic Picture Content.
INSTITUTION Hawaii Univ., Honolulu. Coll. of Education.
PUB DATE Apr 72
NOTE 20p.; Paper presented at the Association for Educational Communication and Technology Annual Convention (Minneapolis, Minnesota, April 16-22, 1972)

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Color; *Color Presentation; Intermode Differences; *Motion; *Perception; Teaching Methods; *Visual Perception

ABSTRACT

A study was devised to determine whether, if color is found superior to black-and-white for communicating dynamic picture content, that superiority can be attributed to the realism of authentic color, or whether that superiority is the effect of the simple presence of color. A sample of 90 sixth grade students were shown slides, half of which depicted dynamic events and half showed static situations. The slides were produced in three versions: black-and-white, authentic color, and contrived color (without the normal color reversal step in production). Subjects were asked to write down what they saw immediately after viewing each picture, and their responses were scored for describing picture content as dynamic or non-dynamic. Results supported the hypothesis that the realism of authentic color communicates dynamic picture content better than either black-and-white or the simple presence of color. (SH)

ED 062822

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EFFECTS OF BLACK AND WHITE, AUTHENTIC AND CONTRIVED COLOR ON CHILDREN'S PERCEPTIONS OF DYNAMIC PICTURE CONTENT

CLAYTON J. VOLLAN, PH.D.

EDUCATIONAL COMMUNICATIONS
COLLEGE OF EDUCATION
UNIVERSITY OF HAWAII
HONOLULU, HAWAII

PAPER PRESENTED AT THE ANNUAL MEETING OF THE ASSOCIATION FOR EDUCATIONAL COMMUNICATIONS AND TECHNOLOGY, MINNEAPOLIS, MINNESOTA, APRIL 16-21, 1972.

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EFFECTS OF BLACK AND WHITE, AUTHENTIC AND CONTRIVED COLOR ON CHILDREN'S PERCEPTIONS OF DYNAMIC PICTURE CONTENT

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INTRODUCTION

Recent discussion of "visual literacy" in education has tended to obscure the fact that much of behavior which would fall under such a rubric has a considerable educational history. The use of pictures as illustrations or examples has long played an important part in the development of educational materials. Particularly during this century, the rapid advance of technology has provided a quantum leap in the quantity of such materials. The application of photography as a practical process, the invention of more sophisticated printing technology and the spectacular economic abundance developed in the industrial nations have brought an avalanche of pictorial materials, not only to the educational setting, but to most aspects of our everyday lives.

Fleming (1966) found after careful analysis of 40 textbooks that his sample contained an average of 1.58 illustrations per page. Each year thousands of line drawings and photographs, both black and white and full-color are located, converted to plates and printed in textbooks. Slide sets, filmstrips, and collections of study prints add further to the rapidly growing quantity of still pictorial images available to the

classroom teacher. All this is executed with little understanding of how pictures can be used best to facilitate the most effective learning.

PREFERENCE FOR "REALISTIC" PICTURES

Rudisill (1952), Rodriquez Bou (1950) and Spaulding (1956) have found that viewers, when presented with a selection of pictures ranging from low to high fidelity consistently expressed a preference for the most "realistic, or lifelike of the offerings. Rudisill indicates for the first time in her study that children's preference for realism in pictures is so strong as to cause them to prefer accurate black and white photographs over colorfully drawn illustrations. Color, however, is an important factor as well, if it contributes to realism. The most preferred pictures, at tested grade levels, kindergarten through six, were realistic full-color photographs. This preference increased from a slight majority at the kindergarten level to overwhelming preference, 80 to 90 percent, at the fourth, fifth, and sixth grade levels. Although these preferences have been well known in the field, they have been thought to have little bearing on learning.

LEARNING FROM REALISTIC PICTURES

Travers (1969) provided evidence that viewer preference for realistic materials may not be a simple whimsy, or a purely esthetic matter. He found that viewer preference for realistic

pictures may be related to improved perception of the pictures' content. "Dynamic" picture content (themes, implied motion) is reported with significantly greater frequency if the viewer sees realistic full-color photographs, than if the viewer sees less realistic pictures. Until the Travers study, there had been little reason to believe that the added expense of accurately picturing phenomena was any more than a frill pandering to the preferences of a needlessly demanding viewer. Color had been considered educationally justifiable only in cases where color was believed a critical attribute of the object being pictured.

Taken at face value, Travers' study would suggest that when dynamic content is intended, and Travers himself contends that a very large percentage of textbook pictures intend such, pictures should be made as realistic as possible. Such realism, according to his study, will facilitate the viewer's correct interpretation. Thus, as Travers indicates, for the purpose of communicating dynamic content, full-color photographs appear to be significantly superior to black and white photographs or any other less realistic picture.

Following earlier thinking, full-color photographs can be determined to be more realistic than other forms used in the Travers' study because full-color photographs are "less arbitrary" (Ogden and Richards, 1923), "less abstract" (Dale, 1954), more amenable to "objective classification" (Edling, 1966) and are "higher in fidelity-to-reality" (Gibson, 1954). It may be, as Travers contends, that the greater realism of pictures

appearing in full-color is responsible for their reported superiority in communicating dynamic picture content. But determining that pictures appearing in full-color are more realistic than pictures with fewer cues does not insure that the realistic nature of full-color pictures is responsible for the increased perception of dynamic picture content. Travers, by treating full-color and reality as one, neglected to suggest the possibility that the superiority he found for full-color might be the result of the mere presence of color, rather than the realistic nature of color used in his study.

Previous studies (Spaulding, 1955; Holmes, 1963) have shown that we should not be guided by the intuition of the communicator when producing pictures for others. We should also beware of using intuition to ascribe usefulness to an attribute, such as realism, when it is confounded with another variable, such as full-color, simply because the outcome fits our preconceptions. Assumptions about the communicative value of pictures have proved wrong too often for this confidence.

PURPOSE OF THIS STUDY

Thus, Travers' study raises an engaging and important question: Do subjects viewing full-color photographs report the perception of "dynamic" picture content with greater frequency because of the "realistic" nature of such photographs, or do subjects perceive "dynamic" picture content because color, realistic or otherwise, helps them to better interpret the content

of the picture?

This study investigates the effect of color in two forms: realistic full-color, hereafter called authentic color, and non-realistic color, hereafter called contrived color. Separating the variables of color and realism will allow this study to determine whether, if color is found superior to black and white for communicating dynamic picture content, that superiority can be attributed to the realism of authentic color, or whether that superiority is the effect of the simple presence of color.

METHODOLOGY

Subjects

This study used a sample of 90 sixth grade students who were members of three intact classes from a suburban Seattle school district which assigns students to classes by a computer-generated random number list. No subjects had been transferred between classes during the term. Differences in age and acuity of color perception were considered to be evenly distributed among the three classes of subjects. No subjects were reported to have irregularities of vision considered outside normal classroom norms. Sex ratios were determined for the study population and for the population from which the sample was drawn. Although the sample favored males slightly (+2.8%), the difference is within expected limits for a sample of this size.

Treatments

Twenty-four still photographs were produced, 12 showing

dynamic events arrested "in motion" by high speed photography. The other 12 photographs showed static situations. Each of the 24 photographs was produced on a 35mm transparency film in three versions (hereafter called "production versions"), a black and white positive form, one in authentic color (Kodak Ektachrome), and a contrived color form, for a total of 72. The contrived color transparencies were produced by elimination of the color reversal step used to produce normally colored transparencies. The contrived versions of the photographs thus appeared in an unrealistic reversal of the color normally associated with the picture content. For example, Caucasion skin color appeared as purple while blue skies appeared as red.

The 24 slides presented to each group of subjects were equally divided among the three production versions, eight in black and white, eight in authentic color and eight in contrived color. In each set of eight pictures representing a production version, four depicted static scenes and four dynamic scenes. Each of the three groups of subjects were shown the same picture content, presented in one of the three alternate production versions. Thus, if group one were to see a black and white "dynamic" content picture of a man throwing a ball, group two would view that picture in contrived color, and group three in authentic color. Distribution of pictures according to scene content, dynamic or static character, and production is presented in the Presentation Matrix. Order

of presentation of the 24 slides assigned to each treatment was determined through use of a table of random numbers.

Scenes Depicted			Groups		
			1	2	3
Woman typing	DYNAMIC	1	B & W	Con Color	Auth Color
Boy throwing ball		2	Con Color	Auth Color	B & W
Man jumping down		3	Auth Color	B & W	Con Color
Man lifting car hood		4	B & W	Con Color	Auth Color
Man getting out of car		5	Con Color	Auth Color	B & W
Man opening door		6	Auth Color	B & W	Con Color
Dolphin jumping		7	B & W	Con Color	Auth Color
Girl swinging		8	Con Color	Auth Color	B & W
Children pushing toy		9	Auth Color	B & W	Con Color
Toddler toddling		10	B & W	Con Color	Auth Color
Boy drinking		11	Con Color	Auth Color	B & W
Man dropping ball		12	Auth Color	B & W	Con Color
Man reading	STATIC	13	B & W	Con Color	Auth Color
Boat at dock		14	Con Color	Auth Color	B & W
Man by car		15	Auth Color	B & W	Con Color
Flower limb		16	B & W	Con Color	Auth Color
House and drive		17	Con Color	Auth Color	B & W
Hippie standing		18	Auth Color	B & W	Con Color
Baby in crib		19	B & W	Con Color	Auth Color
Steps		20	Con Color	Auth Color	B & W
Climbers resting		21	Auth Color	B & W	Con Color
Moss on rock		22	B & W	Con Color	Auth Color
Boy holding bat		23	Con Color	Auth Color	B & W
Mountain		24	Auth Color	B & W	Con Color

Figure 1

Presentation Matrix

Data concerning reported perceptions of static pictures were not analyzed because pictures showing static situations were not under study. Such pictures were included in each treatment to provide a more representative group of pictures to insure that subjects would not be conditioned

for the perception of dynamic picture content through the exclusive use of pictures having dynamic content. Had only pictures with dynamic content been presented, subjects may have begun to predict the dynamic nature of subsequent picture content. Such a prediction by subjects would have introduced to this study a training variable bringing about a possible bias toward the perception of dynamic content.

When the three group presentations are shown as a fractional factorial design with repeated measures, and the data for reported perceptions of static pictures is excluded, the overall experiment can be represented as shown in Figure 2.

		Group I			Group II			Group III		
		a_1			a_2			a_3		
		Production Versions			Production Versions			Production Versions		
		b_1	b_2	b_3	b_1	b_2	b_3	b_1	b_2	b_3
Slide Sets	c_1									
	c_2									
	c_3									

Figure 2

Three Group Presentation
Cell Distribution

When combined for statistical purposes:

a_1, b_1 c_1	a_2, b_2 c_1	a_3, b_3 c_1
a_3, b_1 c_2	a_1, b_2 c_2	a_2, b_3 c_2
a_2, b_1 c_3	a_3, b_2 c_3	a_1, b_3 c_3

Figure 3

Combined Cells from Three Group Presentation

Procedures

Each treatment of 24 slides was presented in subdued lighting. A light equivalent to an 18 percent grey field illuminated the screen at all times except when interrupted by the tachistoscopic projection of the experimental pictures. An 18 percent grey field was selected because it most closely represents the lighting of an average scene and prepared the subjects vision for the projected pictures as well as to orient subjects to the area of the screen where the pictures were shown.

Travers' (1969) study provided a viewing time of 0.25 seconds for each picture but allowed a number of repetitions

of each picture. This was appropriate for the Travers study because he was investigating, in part, how subjects accumulate information about picture content over a number of brief viewings of the same picture. The procedure in this study did not allow for repetition of pictures, because accumulation of perceptions of content over numerous viewings was not under study. Since subjects in this study had only one viewing opportunity, approximately 0.50 seconds was allowed for viewing. Subjects were asked to write down "what they saw" immediately after viewing each picture. Ninety seconds was allowed between tachistoscopic projections for this purpose. The grey field projection appearing on the screen during the 90 second response time insured that subjects had sufficient light to write responses.

Apparatus

For this study the author developed a two-field tachistoscope which used two Kodak Ektagraphic AF (Automatic Focus) carousel-type projectors. Both projectors were fitted with Ektanar f 3.5 zoom lenses and used 500 watt CBA lamps. Zoom lenses provided for matching of the screen size of images shown by the two projectors. Thus, the grey field and the interrupting tachistoscopic projection of the experiment pictures occurred in the same screen area. The apparatus provided for the grey field projection to be blocked by a sliding mirror while each picture was projected, thus

avoiding any washing out effect of the projected pictures that continual projection of the grey field would have produced.

Scoring

Subjects' responses were scored for describing picture content as dynamic or non-dynamic. A sampling of verbs used in the subjects' responses was taken using one-third of student response forms drawn by lot (Backstrom and Hursh, 1963, p. 155). Previous to the scoring of response forms, protocols were established for the scoring of responses using the verbs which were collected from the sample. Responses using only the verbs "standing" or "watching", for example, were not scored as a report of dynamic picture content. Conversely verbs like running, throwing and jumping, clearly report dynamic content.

Response forms were scored working back and forth across the three groups tested to evenly distribute any tendency to vary the scoring system over time. Scoring of all responses preceded the separation of data for production versions so that no scoring bias toward the outcome of the production versions was possible.

Quantification of scoring consisted of a score of one for a dynamic scene correctly described as dynamic and a score of zero for a dynamic scene described as non-dynamic. The scoring system used reflects description of dynamic picture content as dynamic or non-dynamic, not the degree of dynamism present in the picture content or described by the subjects. Scores of the three production versions and the specific content

of pictures scored were retrieved from the scored raw data by use of the random numbers lists originally used to randomize the pictures for treatment. Production version scores were then totaled for each subject. Subjects' number of responses correctly describing dynamic content were then totaled for each production version. Subjects' scores for production versions were then squared and summed.

RESULTS

Analysis of variance for a fractional factorial design (Kirk, 1969) was used to construct an analysis of variance table.

Table 1

Analysis of Variance Table

Source	Sum of Squares	*df*	Mean Square	*F*
Between Subjects	167.3518	89		
Between Groups	8.0963	2	4.0481	2.729 (NS)
Within Groups	159.2555	87	1.4856	
Within Subjects	196.0010	180		
Between Production Versions	56.8073	2	28.4036	41.2903*
Between Slide Sets	15.3407	2	7.6735	11.1503*
Residual	4.1407	2	2.0703	3.0095 (NS)
Error (within)	119.7114	174	.6879	
Total	363.3519	269**		

*P < .01 **N-1=269 NS = Not significant

F ratios were found to be significant beyond the .01 level for both the variance attributable to differences among production versions and for the variance attributable to differences among pictures grouped as sets. No other significant variance was found.

Variance between slide sets attributable to the effect of specific picture content, aside from the dynamic nature of the scene, was expected and controlled in the experimental design of this study. The fractional factorial design with repeated measures was used to insure that the difference in ability of specific pictures, grouped as sets, to elicit descriptions of dynamic content would be evenly distributed across the three production versions and across the three groups, during the three presentations. Thus if one set of pictures tended to communicate dynamic content to a different degree than pictures in another set this variable will interact with a different one of the three production versions during each of the three presentations.

In order to locate the source of the variance among production versions found to have a significant F ratio, means for the three production versions were ranked in order of magnitude and differences between the means calculated.

Table 2

Production Version Data

Production Versions	Mean	SD	N
Black and White	2.856	1.045	90
Authentic Color	3.267	.969	90
Contrived Color	2.156	1.189	90

Table 3

Differences Among Production Version Means

Production Versions	Means	$\bar{X}_2$	$\bar{X}_1$	$\bar{X}_3$
Authentic Color	$\bar{X}_2 = 3.267$	-----	.411*	1.111*
Black and White	$\bar{X}_1 = 2.856$		-----	.700*
Contrived Color	$\bar{X}_3 = 2.156$			-----

*P < .01

Honestly Significant Difference at .05 = .0765

Honestly Significant Difference at .01 = .0963

Differences found between production version means were examined for significance using Tukey's HSD (honestly significant difference) test. Tukey's HSD test was selected for use in this study because of its sensitivity to pair-wise comparisons (Kirk, 1969, p. 88) and thus its appropriateness for comparing a small number of means such as are found in this study.

Using Tukey's HSD test, differences between all production version means were found to be significant at the .01 level. The authentic color production version mean was found to be significantly greater than the mean for the black and white production version at the .01 level. The mean for the black and white production version was found to be significantly greater than the mean of the contrived color production version at the .01 level.

DISCUSSION

This study lends support to viewer preferences for realistic pictures (Rodriquez Bou, 1950; Rudisill, 1952; Spaulding, 1956). If pictures are intended to produce in viewers an interpretation of action, process, or on-goingness, then it appears viewers have been unknowingly correct in preferring pictures that contain the most accurate depiction of reality. This study also supports Travers' (1969) evidence that viewers report dynamic picture content with significantly greater frequency when pictures appear in color, rather than black and white. Further, this study demonstrates that it is not the simple presence of color, but rather the degree to which color represents reality which is responsible for the increase in reported perceptions of dynamic content.

Pictures presented in contrived, non-realistic colors, produced significantly fewer reports of dynamic picture content than either authentically colored pictures or those appearing in black and white. Pictures appearing in black and white produced a significantly greater frequency of reports of dynamic picture content than pictures appearing in contrived colors. Black and white pictures, although they do not share the attribute of color with authentically colored pictures, can be considered as more realistic than pictures in contrived color. Although black and white pictures fail to represent, they do not contradict, the specific color

attributes present in the scene as it appears in nature. Pictures in contrived color, although they share the general attribute of color with authentically colored pictures, contradict every specific color attribute of the scene as it appears in nature and must be considered as less realistic than black and white pictures.

Thus pictures which appear in contrived colors are not simply another kind of colored picture. Such pictures must be considered another kind of picture altogether than a picture appearing in authentic color. Using Gibson's (1954) "low-to-high fidelity continuum" for pictorial illustrations this study would rate pictures appearing in contrived color at the low fidelity end of the scale, pictures appearing in black and white at the middle of the scale, and pictures appearing in authentic color at the high fidelity end of the scale.

Knowlton (1966) discussed the lack of precision inherent in using pictorial illustrations in contrast to the precision possible with language. It is undoubtedly true that pictures lack the precision of language, but pictures have an evocative value not often found in language. A great author or a master storyteller may "breathe life" into a tale woven with words, but a picture, often taken by the most amateurish of photographers, can frequently spring to life in the mind's eye. Ogden and Richards (1923) state that as the "sign", in this case a picture, becomes more like the thing it represents, the "referent", it may be confused

with the referent. This study shows that the tendency to see the sign and the referent as one is facilitated by the subjects' tendency to generalize the sign's similarity to the referent in such a way as to provide the sign with additional attributes of the referent. In this study it appears that the subjects perceived that the sign had more implied attributes of the referent as the number of actual attributes shared by the sign and the referent increased. Thus, as signs become more like their referents, moving along Gibson's (1954) "low-to-high fidelity continuum," from contrived color, to black and white and to authentic color, subjects appear to generalize additional attributes, such as motion, to the sign from their own experience with similar referents.

The tentative hypothesis for the superiority of authentically colored pictures in communicating dynamic content in still pictures is that as the surrogate becomes more realistic, the viewer provides the next level of attribute that is implied in the surrogate from his own store of experience.

Both this study and Travers' (1969) study were, in part, concerned with providing empirical data for those involved in the design of pictures to be printed on a flat surface. Neither author can claim with certainty that their results are generalizable to that medium. Both studies used a means other than the flat printed picture, held in the subjects' hands, for the presentation of the pictures. Further study is necessary to determine whether the results obtained in these experimental settings can be generalized to subjects' reactions to pictures appearing on the printed page.

This study provides further evidence to support the value of realistic pictures for use in teaching-learning activities. However, unless applied to bringing about increased learning, the use of authentically colored pictures to increase reported perceptions of dynamic picture content is little more than an intellectual curiosity. Further study is needed to investigate how such an increase bears on both students' interest in the picture and students' motivation to know more about the scene being pictured.

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